MODIS Total Precipitable Water

Product Description

The MODIS Precipitable Water Product (MOD 05) consists of column water vapor amounts. During the daytime, a near-infrared algorithm is applied over clear land areas of the globe and above clouds over both land and ocean. Over clear ocean areas, water vapor estimates are provided over the extended glint area. An infrared algorithm for deriving atmospheric profiles is also applied both day and night for Level 2.

Both daily Level 2 (MOD 05) and daily, 8-day, and monthly Level 3 (MOD 08) gridded averages are included. The Level 2 data are generated at the 1-km spatial resolution of the MODIS instrument using the near-infrared algorithm during the day, and at 5×5 1-km pixel resolution both day and night using the infrared algorithm when at least 9 FOVs are cloud free. The infrared-derived precipitable water vapor is generated as one component of product MOD 07, and simply added to product MOD 05 for convenience. Level 3 data are computed on 0.5° latitude and longitude, equal area and equal angle grids.

The solar retrieval algorithm relies on observations of water vapor attenuation of reflected solar radiation in the near-infrared MODIS channels so that the product is produced only over areas where there is a reflective surface in the near IR.

Research & Applications

The near-infrared total column precipitable water is very sensitive to boundary layer water vapor since it is derived from attenuation of reflected solar light from the surface. This data product is essential to understand the hydrological cycle, aerosol properties, aerosol-cloud interactions, energy budget, and climate. Of particular interest is the collection of water vapor data above cirrus cloudiness, which has important applications to climate studies. MODIS will also provide finer horizontal scale atmospheric water vapor gradient estimates than are currently available from the POES.

Data Set Evolution

The solar column water vapor parameter is derived from the attenuation by water vapor of near IR solar radiation. Techniques employing ratios of water vapor absorbing channels 17, 18, and 19 with the atmospheric window channels 2 and 5 are used. The ratios remove partially the effects of variation of surface reflectance with wavelength and result in the atmospheric water vapor transmittances. The column water vapor amounts are derived from the transmittances based on theoretical radiative transfer calculations and using look-up table procedures. MODIS is the first space instrument to use near IR bands together with the traditional IR bands to retrieve total precipitable water. Experience in this

MOD 05, MOD 08
PRODUCT SUMMARY

Coverage:
global

Spatial/Temporal Characteristics:
varies with retrieval technique;
1 km near-infrared daylight only, and
5 km infrared day and night (Level 2),
0.5° (Level 3)/daily, 8-day, and monthly

Key Science Applications:
hydrological cycle climatology, effect on aerosol and clouds, atmospheric correction, characterization of the atmosphere

Key Geophysical Parameters:
atmospheric total column water vapor

Processing Level:
2, 3

Product Type:
standard, at-launch

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retrieval is based on an AVIRIS instrument aboard an ER-2 aircraft. Atmospheric water vapor should be determined with an accuracy of 5-10%.

The thermal column water vapor parameter is derived by integrating the moisture profile through the atmospheric column. Other split window methods also exist. This class of techniques uses the difference in water-vapor absorption that exists between channel 31 (11 µm) and channel 32 (12 µm).

Data validation will be conducted by comparing these data with water vapor measurements from the NWS radiosonde network, from ground-based upward-looking microwave radiometers, and from a ground-based sunphotometer network. Quality control will be performed in two dimensions. The first will be comparisons of specific validation sites across as many different climatic and geographic regions as possible. The second will be a statistical analysis of the entire data set.

Suggested Reading

Gao, B.-C. and A.F.H. Goetz, 1990.

Gao, B.-C., *et al.*, 1993.

Green, R.O. and J.E. Conel, 1995.

Jedlovec, G.J., 1987.

Kaufman, Y.J. and B.-C. Gao, 1992.

King, M.D., *et al.*, 1992.

Kleepsies, T.J. and L.M. McMillan, 1984.

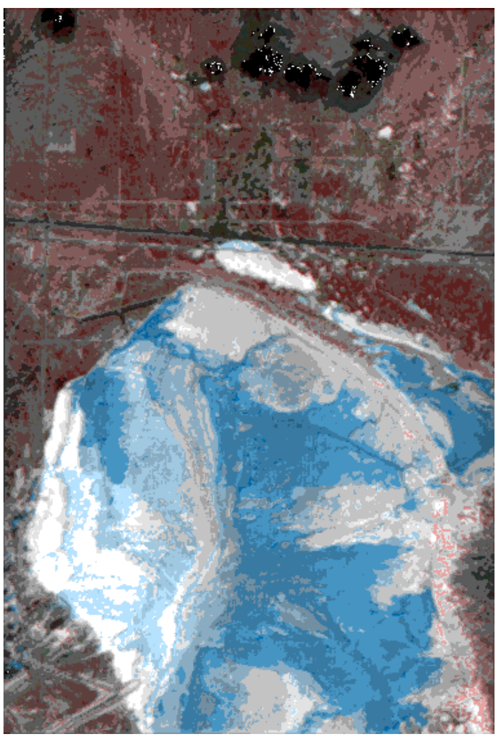

Figure 16. **Total Precipitable Water** (Green and Conel, 1995). The figure on the left represents an AVIRIS false color image of Rogers Dry Lake, California, while the figure on the right corresponds to derived column water vapor. In the water vapor image, black represents precipitable water of 1.2 cm and white precipitable water of 1.5 cm. The spatial variability of water vapor values is up to 20% over this topographically uniform terrain, but is easily detectable from measurements of solar radiation reflected by the surface in the near-infrared spectral region.